A FIVE BY FIVE ELEMENT S-BAND COUPLED OSCILLATOR ARRAY WITH DIAGNOSTIC SYSTEM

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It has been suggested and demonstrated both theoretically and experimentally that an array of electronic oscillators coupled to nearest neighbors will provide a set of signals with linear phase progression across the array. [R. A. York, IEEE Trans., MTT-41, pp.1799-1809][P. Liao and R. A. York, IEEE Trans., MTT-41, pp. 1810-1815] [R. J. Pogorzelski, to appear in MWGWL, December 2000.] The rate of phase progression is controllable by adjusting the tuning (free running frequency) of the oscillators on the perimeter of the array. Such a set of signals is suitable for excitation of an array of equally spaced radiating elements thus producing a steerable radiated beam.

In this paper a two-dimensional array based on this principle is described. It consists of 25 S-band voltage controlled oscillators in a 5 by 5 square configuration coupled to nearest neighbors by microstrip transmission lines. The coupling strength is controlled by series chip resistors at the ends of the lines and the Q of the coupling network is decreased by means of parallel terminating chip resistors across the lines at each end.

The phase progression across the array is measured by a unique diagnostic system. The system is based on a set of mixers and quadrature hybrids used as phase detectors to indicated the phase differences between oscillators. The signals are coupled from the oscillator board by means of an array of microstrip couplers in which the output line of each oscillator is coupled to a transmission line on a separate circuit board sandwiched against the oscillator board. The mixer outputs are digitized and fed to a computer running a virtual instrument in Labview. The inferred phase differences are integrated to produce phase relative to the center element and then displayed as a three dimensional surface plot. The radiating aperture consists of a five by five array of microstrip patches on yet another circuit board. The patches are excited by pins extending through the oscillator circuit board and then through the aperture board to each patch. Thus, the diagnostic system can be attached or removed as a unit leaving the oscillator board and the radiating aperture intact.